

11/10/04

## BUNKER C TANK INVESTIGATION

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Seattle, Washington

Prepared for

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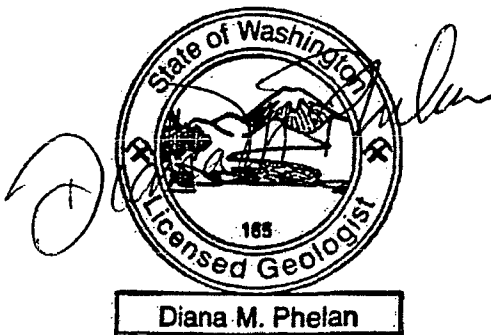
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Work for this investigation was performed in accordance with generally accepted professional standards and practices for the type of work performed. While information regarding subsurface conditions, including soil and ground water quality, is believed to be generally representative of conditions at the site, conditions may change within short distances. Additional subsurface materials and contaminants may be present at locations not investigated during this study.



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## **Introduction**

This report presents the results of a field investigation conducted on September 22, 2004, in the vicinity of three Bunker C underground storage tanks, located at the southeast corner within the Federal Center South facility at 4735 East Marginal Way South in Seattle, Washington (Figure 1). The objective of this field investigation focused on assessing soil and ground water quality in the vicinity of the tanks to determine if a release of Bunker C heating oil has occurred. The scope of work for the field investigation included drilling soil borings at eight locations around the tanks using the push probe drilling method and collection of soil and ground water samples for chemical analysis. Cascade Drilling, Inc. of Woodinville, Washington provided the push probe drilling services and OnSite Environmental Inc. of Redmond, Washington analyzed the water and soil samples.

## **Site Description and Background**

The layout of the three underground Bunker C tanks and vicinity are shown on Figure 2. The tanks will be referred in this report (from north to south) as Tank 1, Tank 2, and Tank 3. The tanks are located east of Building 1206 at the southeast corner within the Federal Center South facility. It is assumed that the tanks were installed at the same time the surrounding buildings were constructed, sometime in the late 1930s (Herrera 2001). The boilers located in the southeastern corner of Building 1201 originally operated on Bunker C heating oil supplied from these tanks; currently the boilers operate on natural gas (Herrera 2001). It is assumed that the tanks were last used sometime in the late 1970s or early 1980s (Galloway 2004).

All three tanks are situated side by side, with their long axes oriented east-west. Concrete vaults containing the vent piping system are situated on top of the west end of each tank, and concrete vaults containing the fill ports are situated on top of the east end of each tank. Measurements taken from inside these vaults indicate that the top of each tank is situated approximately 4 feet below ground surface. The switch box associated with these tanks is located in an underground vault, immediately southwest of Tank 3 (Galloway 2004). Pipelines from each tank converge at one of two underground concrete vaults, each containing a fuel pump system (Galloway 2004). The pipelines delivered heating oil from the tanks to the boiler room in Building 1201 through piping located in an underground utility tunnel that connects buildings 1201 and 1206 (Herrera 2001). Other underground utilities identified in the vicinity of the tanks by a private utility locate conducted prior to drilling activities, included a water line connected to a fire hydrant, two water valves, and a stormwater drainage system.

Each tank has a capacity of 20,000 gallons. Tank 1 contains 8.25 feet of liquid with a hydrocarbon-like odor, based on measurements observed on a dipstick located inside the vent vault; it is unknown whether this tank is full of petroleum product or a mixture of product and water. Both Tanks 2 and 3 have between 1 and 3 feet of black sludge exhibiting a hydrocarbon-like odor at the bottom of each tank.



Notes: ND (250) indicates constituent was not detected above the practical quantitation limit shown in parentheses.  
No samples were collected from P1 and P6.

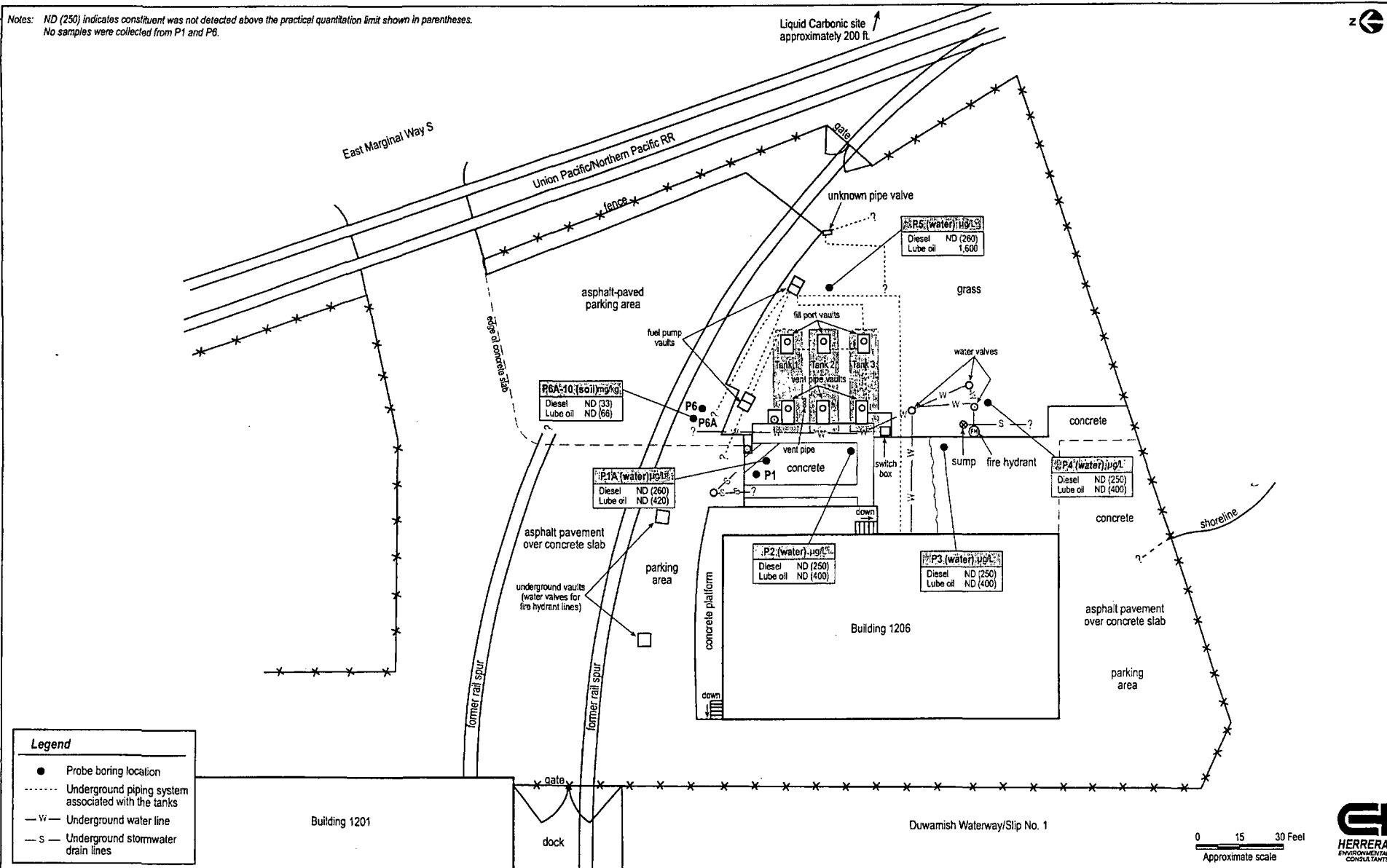


Figure 2. Petroleum hydrocarbon results for ground water and soil samples from probe borings at the Bunker C tank area, Federal Center South, Seattle, Washington.

During a 2001 Phase I environmental site assessment conducted on the Federal Center South facility, the Liquid Carbonic site, located approximately 200 feet east-southeast (upgradient) of the tank area, was identified as a recognized environmental concern. The site had identified petroleum and metals contamination in ground water onsite with a potential to migrate offsite, negatively impacting properties located downgradient with respect to ground water flow, including the Federal Center South facility and tank area (Herrera 2001). This site also was listed on Ecology's UST database as previously having underground storage tanks, including two heating oil tanks; all tanks have been removed (Ecology 2004). Concentrations of diesel- and lube oil-range hydrocarbons, arsenic, chromium, and lead detected in ground water collected at this site exceeded MTCA method A cleanup criteria; diesel and lube oil concentrations detected in ground water collected at this site were 1,470 micrograms per liter ( $\mu\text{g/L}$ ) and 994  $\mu\text{g/L}$ , respectively. In 1997, the Liquid Carbonic site was issued 'No Further Action' (NFA) status by Ecology with provisions of a restrictive covenant requiring institutional controls implemented at the site (Ecology 2004).

Two abandoned rail spurs are located north of the tanks. Portions of the parking lot and driveway west and northwest of the tanks are covered by a 9-inch thick concrete slab, topped with asphalt pavement; the remaining parking area to the northeast is asphalt-paved. Two underground vaults, each covered by a steel plate, observed in the parking area north of Building 1206 contain valves associated with the water fire hydrant lines (Galloway 2004).

### **Regional Geology and Hydrogeology**

The Puget Sound Lowland has undergone physiographic and depositional changes due to a least four glacial episodes. The last glaciation that occurred in the region was the Vashon Stade of the Fraser Glaciation, which ended approximately 13,500 years ago. The advance of the Vashon Glacier deepened and widened north/south trending valleys. Thick glacial drift deposits consisting of outwash sands and gravels, and till were deposited over the greater Puget Sound area.

The Duwamish River valley is a north/south trending trough situated between rounded hills composed almost exclusively of glacial deposits. The deposits observed and mapped along the riverbank in this area consist of post-glacial alluvial deposits of an interlayered series of silt, sand, gravel, and organic material. The alluvial deposits in the Duwamish River valley are more than 100 feet thick and are intercalated with marine embayment sediments of sand and silt (Galster 1991). Isolated pockets of peat and other organic material are also present in areas of accumulation in old meander channels and other depressions. Much of the lower portions of the Duwamish River valley has been developed and modified using artificial fill consisting of sediments of sand and silt. This fill material ranges in depth from less than five feet to more than 50 feet in old river channels.

The Federal Center South facility, including the tank site and vicinity, is flat, bordering the east side of the Duwamish Waterway at an approximate elevation of 5 to 10 feet above mean sea level (USGS 1983). Portions of Building 1206 and parking areas to the west and southwest of

the building are situated on a pier over the Duwamish Waterway and Slip No. 1, a former river channel of the historic Duwamish River that has been modified into a turning basin and ship docking area. Ground water encountered during the tank investigation ranged from 9 to 11 feet below ground surface. Ground water is generally expected to flow to the west toward the Duwamish Waterway, but flow may change to a southern or eastern direction due to tidal influence through the waterway and former river channels from Elliott Bay and Puget Sound, located approximately 2 miles to the north.

## **Sample Locations, Collection Procedures, and Chemical Analysis**

Boring locations were established based on locations of the tanks, associated piping, and other tank-related equipment, as well as the assumed direction of ground water flow. Specific locations were limited due to various known and suspected underground utility lines and trenches identified either by private utility locate or visual observations (e.g. evidence of trenches in concrete slab, cracks). A site map of the tank area was produced and boring locations marked prior to drilling activities using a 100-foot measuring tape (Figure 2). The boring locations were established as follows:

- Probe borings P1, P1A, P2, P3, P4, P6, and P6A were located downgradient to the northwest, west, and southwest from the three tanks.
- Probe boring P5 was located upgradient to the east of the tanks.

Following utility clearance and prior to drilling activities, the driller cut and removed 3-inch diameter concrete cores at boring locations P1, P1A, P2, and P3 to expose soil beneath the concrete slab.

Six probe borings were driven to depths ranging from 12 to 16 feet below ground surface until ground water was encountered. Boring P1 was terminated at 6 feet below ground surface due to refusal; the presence of pea gravel at the bottom of this boring indicate a possible utility trench. Boring P6A was drilled near P6 to obtain a soil sample for chemical analysis. Soil samples were collected continuously at 4-foot depth intervals until ground water was encountered at depths ranging from 9 to 11.5 feet below ground surface. Soil samples were retrieved using a decontaminated push drive soil-sampling probe, with a clear Lexan<sup>®</sup> liner. Soil samples were visually classified for lithology, and observed for the presence of contamination and for moisture content indicating the presence of ground water.

A soil sample collected from the 10-foot depth interval from boring P6A was selected for chemical analysis because a ground water sample could not be obtained at this location due to low-permeable silt. The sample was collected within a wet zone observed at 10 feet in P6A, within the assumed water table zone of fluctuation between 9 and 11 feet below ground surface. Soil was retrieved from the liner and placed directly into sample containers provided by the



analytical laboratory. Sample containers were labeled and then stored in chilled coolers prior to being hand-delivered to the laboratory.

### **Ground Water Sample Collection from Push Probe Borings**

Ground water samples were collected from probe borings P1A, P2, P3, P4, and P5 by driving a sealed stainless steel screened probe point to the desired depth, opening the screen, and drawing water via clean dedicated polyethylene tubing connected to a peristaltic pump at the surface. Initial depth to water was determined by the field geologist based on observations of moisture content and permeability of soil samples collected at each probe boring location. Static water level measurements at each boring location were obtained prior to sample collection by lowering a decontaminated electronic water level probe inside the probe rods. Once the water level stabilized and after development (approximately 0.25 to 0.5 gallons water purged from each boring), water samples were collected directly from the tubing into sample containers provided by the laboratory. Care was taken to ensure that no bubbles or headspace were present. Immediately upon filling, each container was securely capped, labeled, and stored in a chilled cooler prior to delivery to the laboratory.

After soil and ground water samples were collected, the probe boreholes were backfilled with bentonite chips, then sealed at the surface with concrete, asphalt patch, or soil, depending on the surrounding ground surface.

### **Investigative-Derived Waste**

Soil cuttings generated during drilling of all eight borings (approximately two 5-gallon buckets) were spread out on the ground surface near the fence and railroad tracks east of the tanks. Decontamination and development water generated during the investigation (less than 2 gallons total) was used to hydrate the bentonite chips placed in each borehole.

### **Sample Analysis**

Five ground water samples collected from probe borings P1A and P2 through P5, and the soil sample collected at the 10-foot depth interval at P6A (sample P6A-10) were submitted under chain-of-custody protocol to the laboratory for analysis of diesel- and lube oil-range hydrocarbons using northwest total petroleum hydrocarbons diesel-extended (NWTPH-Dx) test method. All analytical results were determined to be acceptable for use based on review of the laboratory analytical report, which is included in Appendix B.

## Results

### Subsurface Conditions

Soils encountered in all eight borings consisted of fill material overlying post-glacial alluvial deposits of fine-grained sand and silt. Fill material consisted of fine-grained sand that likely derived from periodic dredging of the Duwamish Waterway; dredged sand is difficult to distinguish from native post-glacial alluvium. Fill started either at ground surface or beneath concrete or asphalt pavement, extending to depths ranging from 6 to 11 feet below ground surface. The original ground surface prior to site development and native post-glacial alluvium were identified underlying the fill in seven of the eight boring locations by the presence of wood chips, black organics, blades of grass, and/or roots or a thin crushed gravel layer. The base of the post-glacial alluvium, which consisted of alternating fine-grained sand and silt, was not reached in any of the probe borings, drilled to maximum depths ranging from 12 to 16 feet below ground surface. Blades of grass and roots observed in silt starting at the 10-foot depth intervals in P6 and P6A indicate that the northern portion of the site was situated over former tidal mudflats, with the southern portion of the site adjacent to Slip No. 1 situated over a sandy riverbank of the historic Duwamish River.

A small chunk of stained soil with a heavy hydrocarbon-like odor was observed in soil collected at the 6-foot depth interval above a pea gravel layer in boring P1. No staining or odors were observed in the pea gravel layer or from soil collected at the seven remaining probe borings. No oily sheen or odors in ground water during development or sampling were observed from borings P1A and P2 through P5.

### Soil and Ground Water Analytical Results

No petroleum hydrocarbons were detected above practical quantitation limits in soil sample P6A-10. Analytical results of ground water samples collected from P1A and P2 through P5 during the field investigation are summarized in Table 1 and illustrated in Figure 2. Lube oil-range hydrocarbons, identified by the laboratory as Bunker C heating oil, were detected in the ground water sample collected from boring P5, located east of the tanks, at a concentration above the Model Toxics Control Act (MTCA) method A ground water cleanup level of 500 micrograms per liter ( $\mu\text{g/L}$ ). No petroleum hydrocarbons were detected above practical quantitation limits in the four remaining samples collected from borings drilled west of the tanks.

## Conclusions and Recommendations

The results of this Bunker C tank investigation indicated that a release of lube oil to ground water has occurred. Lube oil was detected in ground water collected from a boring installed upgradient of the underground tanks relative to the assumed ground water flow direction. There is no indication of widespread contamination surrounding the tanks. It appears that a minor release is restricted to the area immediately adjacent to the tanks that could be removed when the

tanks are closed. Contaminated ground water should be re-assessed following tank and soil removal.

**Table 1. Petroleum hydrocarbon results of ground water samples ( $\mu\text{g/L}$ ) collected from probe borings at the Bunker C tank area, Federal Center South.**

Sample Identification	Diesel-range hydrocarbons	Lube oil-range hydrocarbons
<i>MTCA method A cleanup level<sup>a</sup></i>	<i>500</i>	<i>500</i>
P1A	ND (260)	ND (420)
P2	ND (250)	ND (400)
P3	ND (250)	ND (400)
P4	ND (250)	ND (400)
P5	ND (260)	<b>1,600</b>

ND (250) Indicates constituent was not detected above the practical quantitation limit shown in parentheses. Value in **boldface** type indicates constituent exceeded regulatory cleanup level.

<sup>a</sup> Model Toxics Control Act (MTCA) cleanup regulation (Ecology 2001).

## References

- Ecology. 2001. Model Toxics Control Act Cleanup Regulation, Chapter 173-340 WAC. Washington State Department of Ecology, Toxics Cleanup Program. Publication no. 94-06. Amended February 21, 2001.
- Ecology. 2004. No Further Action (NFA) database available online with the Washington State Department of Ecology, Toxic Cleanup Program. Database last updated by Ecology on 08/05/04. Accessed NFA database on 10/6/04: <http://www.ecy.wa.gov/programs/tcp/NFA/NFApage.htm>.
- Galloway, Bill. 2004. Personal communication (onsite interview during field investigation and telephone conversation with Diana Phelan, Herrera Environmental Consultants) regarding the Bunker C underground tanks. Property manager of the Federal Center South facility for the U.S. General Services Administration since 1985. September/October 2004.
- Galster, Richard W. and William T. Laprade. 1991. Geology of Seattle, Washington, United States of America. Bulletin of the Association of Engineering Geologists, Volume 28, Number 3.
- Herrera. 2001. Phase I Environmental Site Assessment—Federal Center South, Seattle, Washington. Report prepared for the U.S. General Services Administration by Herrera Environmental Consultants, Inc. July 19, 2001.
- USGS. 1983. Seattle South, Washington. Topographic/bathymetric 7.5x15 minute quadrangle map (N4730-W12215/7.5x15). U.S. Geological Survey, Denver, CO.

**ATTACHMENT A**

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**Probe Boring Logs**



## SOIL BORING RECORD

Boring # P1  
 Total depth 6 feet  
 Sheet 1 of 1

Project name BUNKERC Drilling Contractor Cascade Drilling, Inc. Drilling method Push probe drill rig  
 Project number C00-01419-060 Location West-northwest of Bunker C Sampling method 4-foot probe sampler  
 Client U.S. GSA Tank 1, Federal Center South Ground elevation N/A  
 HEC rep. Diana Phelan Start date 9/22/04 Air monitoring (Y/N) No  
 Compl. date 9/22/04 Instrument(s) N/A

Instrument reading (ppm)	Sample type, interval	% recovery	Water level (feet)	Depth (feet, BGS)	Soil group	Soil description
				1		10-inch thick concrete
	4-foot long probe sampler	65		2	SP	Black (10YR, 3/1) fine-grained SAND, moist.
				3		
				4		
	4-foot long probe sampler	10		5		
				6	SM	Brown, silty fine-grained SAND, small chunk of heavy oil hydrocarbon-like staining and odor, moist; then pea gravel, moist.
				7		Encountered refusal at 6 feet; backfilled borehole with bentonite chip seal and capped at the surface with concrete.
				8		No ground water encountered during drilling.
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		



## SOIL BORING RECORD

Boring # P1A  
 Total depth 16 feet  
 Sheet 1 of 1

Project name BUNKERC Drilling Contractor Cascade Drilling, Inc. Drilling method Push probe drill rig  
 Project number C00-01419-060 Location West of Bunker C Tank 1, Sampling method 4-foot probe sampler  
 Client U.S. GSA Federal Center South Ground elevation N/A  
 HEC rep. Diana Phelan Start date 9/22/04 Air monitoring (Y/N) No  
 Compl. date 9/22/04 Instrument(s) N/A

Instrument reading (ppm)	Sample type, interval	% recovery	Water level (feet)	Depth (feet, BGS)	Soil group	Soil description
	4-foot long probe sampler	75		1		10-inch thick concrete with 3/8-inch steel rebar; then 2 inches of pea gravel
				2	SP	Very dark grayish brown (10YR 3/2) fine- to medium-grained SAND, dry to moist.
				3		
				4		
	4-foot long probe sampler	80		5		
				6	SP	Very dark grayish brown (10YR 3/2) very fine- to fine-grained SAND, with a 3-inch thick lens of brown (7.5Y 4/2) SILT, low plasticity, moist.
				7		
				8		
	4-foot long probe sampler	65		9		
				10	SP	Same as above, moist to almost wet, oxidized zone near water level.
			▽ ▼	11		Ground water encountered during drilling at 11.0 feet bgs.
				12		Static water level measured at 11.7 feet bgs.
				13	SM/ML	Very dark gray/black (10YR 3/1, 2/1) silty very fine-grained SAND and very fine-grained sandy SILT, with occasional organics, wet.
				14	ML	Very dark grayish brown (10YR 3/2) SILT, wet.
	4-foot long probe sampler	80		15	SM/ SP-SM/ SP	Very dark grayish brown (10YR 3/2), alternate layers of silty, very fine-grained SAND, slightly silty very fine-grained SAND, and very fine-grained SAND, wet.
				16		
				17		Boring drilled to 16 feet; set bottom of screened probe point at 15 feet and collected P1A ground water sample; backfilled borehole with bentonite chip seal and capped at the surface with concrete.
				18		
				19		
				20		



## SOIL BORING RECORD

Boring # P2  
 Total depth 14 feet  
 Sheet 1 of 1

Project name BUNKERC Drilling Contractor Cascade Drilling, Inc. Drilling method Push probe drill rig  
 Project number C00-01419-060 Location West of Bunker C Tank 3, Sampling method 4-foot probe sampler  
 Client U.S. GSA Federal Center South Ground elevation N/A  
 HEC rep. Diana Phelan Start date 9/22/04 Air monitoring (Y/N) No  
 Compl. date 9/22/04 Instrument(s) N/A

Instrument reading (ppm)	Sample type, interval	% recovery	Water level (feet)	Depth (feet, BGS)	Soil group	Soil description
				1		9-inch thick concrete; then 3-inch thick pea gravel layer.
	4-foot long probe sampler	65		2	SP	Very dark grayish brown (10YR 3/2) fine-grained SAND, dry to moist (Fill).
				3		
				4		
				5		
	4-foot long probe sampler	70		6	SP	Same as above, some very fine-grained SAND, moist.
				7		
				8		
	4-foot long probe sampler	100	▽ ▼	9	SP	Same as above, moist to almost wet, oxidized zone in sand near water level. Ground water encountered during drilling at 10.0 feet bgs.
				10	ML	
				11		Black wood and organics; then very dark gray (10YR 3/1) SILT, moist to wet; static water level measured at 10.7 feet bgs.
				12	SP	Very dark gray/black (10YR 3/1, 2/1), very fine-grained SAND with trace amount of silt, wet.
	4-foot long probe sampler	100		13	ML	Very dark grayish brown (10YR 3/2) SILT, horizontal varve-like layers, with roots, organics, moist to wet.
				14		
				15		Boring drilled to 14 feet; set bottom of screened probe point at 13 feet and collected P2 ground water sample; backfilled borehole with bentonite chip seal and capped at the surface with concrete.
				16		
				17		
				18		
				19		
				20		



## SOIL BORING RECORD

Boring # P3  
 Total depth 14 feet  
 Sheet 1 of 1

Project name BUNKERC Drilling Contractor Cascade Drilling, Inc. Drilling method Push probe drill rig  
 Project number C00-01419-060 Location Southwest of Bunker C Tank Sampling method 4-foot probe sampler  
 Client U.S. GSA 3, Federal Center South Ground elevation N/A  
 HEC rep. Diana Phelan Start date 9/22/04 Air monitoring (Y/N) No  
 Compl. date 9/22/04 Instrument(s) N/A

Instrument reading (ppm)	Sample type, interval	% recovery	Water level (feet)	Depth (feet, BGS)	Soil group	Soil description
	4-foot long probe sampler	70		1		9-inch thick concrete with 3/8-inch thick steel rebar; then 3 inches of pea gravel
	4-foot long probe sampler	95		2	SP	Very dark grayish brown (10YR 3/2) very fine- to fine-grained SAND, dry to moist (Fill).
	4-foot long probe sampler	100		3		
	4-foot long probe sampler			4		
	4-foot long probe sampler			5		
	4-foot long probe sampler			6	SP	Very dark gray (10YR 3/1) very fine- to fine-grained SAND, moist 1-inch thick lenses of very fine-grained sandy SILT/silty very fine-grained SAND, moist.
	4-foot long probe sampler			7		Oxidized stain in sand at 7.5 feet bgs.
	4-foot long probe sampler			8		
	4-foot long probe sampler		▽, ▼	9		Ground water encountered during drilling at 9.0 feet bgs; static water level measured at 9.3 feet bgs.
	4-foot long probe sampler			10	SP/ML/ SP-SM	Black (10YR 2/1) alternate layers of fine-grained SAND, low plasticity SILT, and slightly silty very fine-grained SAND, wet.
	4-foot long probe sampler			11		
	4-foot long probe sampler			12		
	4-foot long probe sampler			13		
	4-foot long probe sampler			14		
	4-foot long probe sampler			15		Boring drilled to 14 feet; set bottom of screened probe point at 14 feet and collected P3 ground water sample; backfilled borehole with bentonite chip seal and capped at the surface with concrete.
	4-foot long probe sampler			16		
	4-foot long probe sampler			17		
	4-foot long probe sampler			18		
	4-foot long probe sampler			19		
	4-foot long probe sampler			20		





## SOIL BORING RECORD

Boring # P4  
 Total depth 14 feet  
 Sheet 1 of 1

Project name BUNKERC Drilling Contractor Cascade Drilling, Inc. Drilling method Push probe drill rig  
 Project number C00-01419-060 Location South of Bunker C Tank 3, Sampling method 4-foot probe sampler  
 Client U.S. GSA Federal Center South Ground elevation N/A  
 HEC rep. Diana Phelan Start date 9/22/04 Air monitoring (Y/N) No  
 Compl. date 9/22/04 Instrument(s) N/A

Instrument reading (ppm)	Sample type, interval	% recovery	Water level (feet)	Depth (feet, BGS)	Soil group	Soil description
	4-foot long probe sampler	45		1		Grass
				2	SP	Very dark gray/black (10YR 3/2, 2/1) fine-grained SAND, dry to moist, with concrete chunks (Fill).
				3		
				4		
				5		
	4-foot long probe sampler	100		6	SP	Same as above, concrete chunks, dry to moist (Fill).
				7		
				8	ML/SM	Grayish brown (10YR 5/2) very fine-grained sandy SILT/silty very fine-grained SAND, with roots, dry to moist.
				9	SP	Black (10YR 2/1) horizontal bands of very fine- to fine-grained SAND, moist; static water level measured at 9.2 feet bgs.
	4-foot long probe sampler	100	▼	10	SP	Very dark grayish brown (10YR 3/2) fine-grained SAND, almost wet; ground water encountered during drilling at 10 feet bgs
			▽	11		Black wood chips at 10 feet bgs.
				12	SP	Black (10YR 2/1) very fine- to fine-grained SAND, with 3-inch thick layer of very fine-grained sandy SILT/SILT, wet.
				13		
				14		
				15		Boring drilled to 14 feet; set bottom of screened probe point at 14 feet and collected P4 ground water sample; backfilled borehole with bentonite chip seal and capped at the surface with soil
				16		
				17		
				18		
				19		
				20		



## SOIL BORING RECORD

Boring # P5  
 Total depth 16 feet  
 Sheet 1 of 1

Project name BUNKERC Drilling Contractor Cascade Drilling, Inc. Drilling method Push probe drill rig  
 Project number C00-01419-060 Location East of Bunker C Tanks, Sampling method 4-foot probe sampler  
 Client U.S. GSA Federal Center South Ground elevation N/A  
 HEC rep. Diana Phelan Start date 9/22/04 Air monitoring (Y/N) No  
 Compl. date 9/22/04 Instrument(s) N/A

Instrument reading (ppm)	Sample type, interval	% recovery	Water level (feet)	Depth (feet, BGS)	Soil group	Soil description
	4-foot long probe sampler	85		1		Grass
				2	SP	Very dark brown/black (10YR 3/3, 2/1) fine-grained SAND, dry to moist.
				3		
				4		
	4-foot long probe sampler	85		5		
				6	SP	Same as above, moist.
				7		
				8		
	4-foot long probe sampler	65		9	SP	Same as above, moist to almost wet.
			▽	10		Ground water encountered during drilling at 10 feet bgs.
			▼	11	ML	Black wood with very dark gray (10YR 3/1) very fine-grained sandy SILT, wet.
				12	SP	Static water level measured at 11.0 feet bgs.
				13		Very dark gray/black (10YR 3/1, 2/1) fine-grained SAND, wet.
	4-foot long probe sampler	85		14		
				15		
				16		
				17		Boring drilled to 16 feet; set bottom of screened probe point at 15 feet and collected P5 ground water sample; backfilled borehole with bentonite chip seal and capped at the surface with soil.
				18		
				19		
				20		



## SOIL BORING RECORD

Boring # P6  
 Total depth 16 feet  
 Sheet 1 of 1

Project name BUNKERC Drilling Contractor Cascade Drilling, Inc. Drilling method Push probe drill rig  
 Project number C00-01419-060 Location North-northwest of Bunker C Sampling method 4-foot probe sampler  
 Client U.S. GSA Tank 1, Federal Center South Ground elevation N/A  
 HEC rep. Diana Phelan Start date 9/22/04 Air monitoring (Y/N) No  
 Compl. date 9/22/04 Instrument(s) N/A

Instrument reading (ppm)	Sample type, interval	% recovery	Water level (feet)	Depth (feet, BGS)	Soil group	Soil description
				1		Asphalt with crushed gravel beneath.
	4-foot long probe sampler	65		2	SP	Very dark brown (10YR 3/3) fine-grained SAND, with trace amount of silt, moist (Fill).
				3		
				4		
				5		
	4-foot long probe sampler	100		6	SP	Same as above, very fine- to fine-grained SAND, with occasional lenses of very fine-grained sandy silt/silty very fine-grained sand, moist (Fill).
				7		
				8		
				9	SP	Same as above, red brick fragments, moist to almost wet (Fill).
	4-foot long probe sampler	60		10	GP	Crushed gravel, wet.
				11	ML	Very dark gray (10YR 3/1) very fine-grained sandy SILT and very dark grayish brown (10YR 3/2) SILT with organics (blades of grass, roots), moist to almost wet.
				12		
				13		
				14		
	4-foot long probe sampler	100		15	ML	Dark grayish brown (10YR 4/2) clayey SILT, with brown blades of grass, black twigs, moist.
				16		
				17		Boring drilled to 16 feet; set bottom of screened probe point at 13 feet in an attempt to collect a ground water sample; no sample collected; backfilled borehole with bentonite chip seal and capped at the surface with asphalt.
				18		
				19		
				20		



# SOIL BORING RECORD

Boring # P6A  
 Total depth 16 feet  
 Sheet 1 of 1

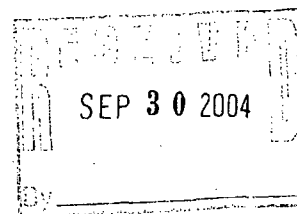
Project name BUNKERC Drilling Contractor Cascade Drilling, Inc. Drilling method Push probe drill rig  
 Project number C00-01419-060 Location About 3 feet WNW of P6, Sampling method 4-foot probe sampler  
 Client U.S. GSA Bunker C Tanks, Federal Center South Ground elevation N/A  
 HEC rep. Diana Phelan Start date 9/22/04 Air monitoring (Y/N) No  
 Compl. date 9/22/04 Instrument(s) N/A

Instrument reading (ppm)	Sample type, interval	% recovery	Water level (feet)	Depth (feet, BGS)	Soil group	Soil description
				1		Asphalt with crushed gravel beneath.
	4-foot long probe sampler	75		2	SP/ SP-SM	Very dark gray/black (10YR 3/1, 2/1) fine-grained SAND and slightly silty fine-grained SAND, with occasional gravel and red brick fragments, moist (Fill).
				3		
				4		
	4-foot long probe sampler	100		5	SP	Very dark grayish brown (10YR 3/2) alternate bands of fine-grained and very fine-grained SAND, moist
				6		
				7		
				8		
P6A-10	4-foot long probe sampler	100	▽	9	SP	Same as above, moist to almost wet, oxidized zone in sand at wet zone.
				10		Wet zone encountered during drilling between 10 and 10.5 feet bgs.
				11	ML	Very dark gray/black (10YR 3/1, 2/1) SILT, wet.
				12	SP	Very dark gray/black (10YR 3/1, 2/1) very fine-grained SAND, wet.
	4-foot long probe sampler	100		13		
				14	ML	Dark gray and gray (10YR 4/1, 5/1) alternate horizontal varve-like bands of SILT and clayey SILT, with roots, black organics, moist.
				15		
				16		
				17		Boring drilled to 16 feet; collected soil sample P6A-10; backfilled borehole with bentonite chip seal and capped at the surface with asphalt.
				18		
				19		
				20		

**ATTACHMENT B**

---

**Laboratory Analytical Report—  
OnSite Environmental Inc.**



September 27, 2004

Bruce Carpenter  
Herrera Environmental Consultants, Inc.  
2200 6<sup>th</sup> Avenue, Suite 1100  
Seattle, WA 98121

Re: Analytical Data for Project C00-01419-060  
Laboratory Reference No. 0409-129

Dear Bruce:

Enclosed are the analytical results and associated quality control data for samples submitted on September 22, 2004.

The standard policy of OnSite Environmental Inc. is to store your samples for 30 days from the date of receipt. If you require longer storage, please contact the laboratory.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning the data, or need additional information, please feel free to call me.

Sincerely,



David Baumeister  
Project Manager

Enclosures

Date of Report: September 27, 2004  
Samples Submitted: September 22, 2004  
Laboratory Reference: 0409-129  
Project: C00-01419-060

#### Case Narrative

Samples were collected on September 22, 2004 and received by the laboratory on September 22, 2004. They were maintained at the laboratory at a temperature of 2°C to 6°C.

General QA/QC issues associated with the analytical data enclosed in this laboratory report will be indicated with a reference to a comment or explanation on the Data Qualifier page. More complex and involved QA/QC issues will be discussed in detail below.

Date of Report: September 27, 2004  
Samples Submitted: September 22, 2004  
Laboratory Reference: 0409-129  
Project: C00-01419-060

## NWTPH-Dx

Date Extracted: 9-23-04  
Date Analyzed: 9-23-04

Matrix: Water  
Units: mg/L (ppm)

Client ID:	P3	P4	P5
Lab ID:	09-129-01	09-129-02	09-129-03
Diesel Range:	ND	ND	ND
PQL:	0.25	0.25	0.26
Identification:	---	---	---
Lube Oil Range:	ND	ND	1.6
PQL:	0.40	0.40	0.41
Identification:	---	---	Lube Oil
Surrogate Recovery			
o-Terphenyl:	85%	75%	76%
Flags:	Y	Y	Y



Date of Report: September 27, 2004  
Samples Submitted: September 22, 2004  
Laboratory Reference: 0409-129  
Project: C00-01419-060

**NWTPH-Dx**

Date Extracted: 9-23-04  
Date Analyzed: 9-23-04

Matrix: Water  
Units: mg/L (ppm)

Client ID:	P1A	P2
Lab ID:	09-129-04	09-129-05

Diesel Range:	ND	ND
PQL:	0.26	0.25
Identification:	---	---

Lube Oil Range:	ND	ND
PQL:	0.42	0.40
Identification:	---	---

Surrogate Recovery		
o-Terphenyl:	86%	84%

Flags:	Y	Y
--------	---	---

Date of Report: September 27, 2004  
Samples Submitted: September 22, 2004  
Laboratory Reference: 0409-129  
Project: C00-01419-060

**NWTPH-Dx**  
**METHOD BLANK QUALITY CONTROL**

Date Extracted: 9-23-04  
Date Analyzed: 9-23-04

Matrix: Water  
Units: mg/L (ppm)

Lab ID: MB0923W1

Diesel Range: ND  
PQL: 0.25  
Identification: ---

Lube Oil Range: ND  
PQL: 0.40  
Identification: ---

Surrogate Recovery  
o-Terphenyl: 84%

Flags: Y

Date of Report: September 27, 2004  
Samples Submitted: September 22, 2004  
Laboratory Reference: 0409-129  
Project: C00-01419-060

NWTPH-Dx  
DUPLICATE QUALITY CONTROL

Date Extracted: 9-23-04  
Date Analyzed: 9-23-04

Matrix: Water  
Units: mg/L (ppm)

Lab ID: 09-129-01 09-129-01 DUP

Diesel Range: ND ND  
PQL: 0.25 0.25

RPD: N/A

Surrogate Recovery  
o-Terphenyl: 85% 88%

Flags: Y Y

Date of Report: September 27, 2004  
Samples Submitted: September 22, 2004  
Laboratory Reference: 0409-129  
Project: C00-01419-060

**NWTPH-Dx**

Date Extracted: 9-23-04  
Date Analyzed: 9-23-04

Matrix: Soil  
Units: mg/kg (ppm)

Client ID: P6A-10  
Lab ID: 09-129-06

Diesel Range: ND  
PQL: 33  
Identification: ---

Lube Oil Range: ND  
PQL: 66  
Identification: ---

Surrogate Recovery  
o-Terphenyl: 72%

Flags: Y

Date of Report: September 27, 2004  
Samples Submitted: September 22, 2004  
Laboratory Reference: 0409-129  
Project: C00-01419-060

**NWTPH-Dx  
METHOD BLANK QUALITY CONTROL**

Date Extracted: 9-23-04  
Date Analyzed: 9-23-04

Matrix: Soil  
Units: mg/kg (ppm)

Lab ID: MB0923S1

Diesel Range: ND  
PQL: 25  
Identification: ---

Lube Oil Range: ND  
PQL: 50  
Identification: ---

Surrogate Recovery  
o-Terphenyl: 95%

Flags: Y

Date of Report: September 27, 2004  
Samples Submitted: September 22, 2004  
Laboratory Reference: 0409-129  
Project: C00-01419-060

**NWTPH-Dx**  
**DUPLICATE QUALITY CONTROL**

Date Extracted: 9-23-04  
Date Analyzed: 9-23-04

Matrix: Soil  
Units: mg/kg (ppm)

Lab ID: 09-131-01 09-131-01 DUP

Diesel Range:	3750	3410
PQL:	25	25
RPD:	10	

Surrogate Recovery		
o-Terphenyl:	121%	111%

Flags:	Y	Y
--------	---	---

Date of Report: September 27, 2004  
Samples Submitted: September 22, 2004  
Laboratory Reference: 0409-129  
Project: C00-01419-060

**% MOISTURE**

Date Analyzed: 9-23-04

Client ID	Lab ID	% Moisture
P6A-10	09-129-06	24



#### Data Qualifiers and Abbreviations

- A - Due to a high sample concentration, the amount spiked is insufficient for meaningful MS/MSD recovery data.
- B - The analyte indicated was also found in the blank sample.
- C - The duplicate RPD is outside control limits due to high result variability when analyte concentrations are within five times the quantitation limit.
- E - The value reported exceeds the quantitation range and is an estimate.
- F - Surrogate recovery data is not available due to the high concentration of coeluting target compounds.
- G - Insufficient sample quantity for duplicate analysis.
- H - The analyte indicated is a common laboratory solvent and may have been introduced during sample preparation, and be impacting the sample result.
- I - Compound recovery is outside of the control limits.
- J - The value reported was below the practical quantitation limit. The value is an estimate.
- K - Sample duplicate RPD is outside control limits due to sample inhomogeneity. The sample was re-extracted and re-analyzed with similar results.
- L - The RPD is outside of the control limits.
- M - Hydrocarbons in the gasoline range (toluene-napthalene) are present in the sample.
- O - Hydrocarbons indicative of diesel fuel are present in the sample and are impacting the gasoline result.
- P - The RPD of the detected concentrations between the two columns is greater than 40.
- Q - Surrogate recovery is outside of the control limits.
- S - Surrogate recovery data is not available due to the necessary dilution of the sample.
- T - The sample chromatogram is not similar to a typical \_\_\_\_\_.
- U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
- V - Matrix Spike/Matrix Spike Duplicate recoveries are outside control limits due to matrix effects.
- W - Matrix Spike/Matrix Spike Duplicate RPD are outside control limits due to matrix effects.
- X - Sample extract treated with a silica gel cleanup procedure.
- Y - Sample extract treated with an acid/silica gel cleanup procedure.
- Z -
- ND - Not Detected at PQL
- PQL - Practical Quantitation Limit
- RPD - Relative Percent Difference





# OnSite Environmental Inc.

14648 NE 95th Street • Redmond, WA 98052  
Phone: (425) 883-3881 • Fax: (425) 885-4603

## Chain of Custody

Page 1 of 1

Company: HERRERA ENVIRONMENTAL  
CONSULTANTS

Project Number:  
C00-01419-060

Project Name:  
BUNKERC

Project Manager:  
BRUCE CARPENTER

Sampled by:  
DIANA PHELAN

### Turnaround Request (in working days)

(Check One)

☐ Same Day ☐ 1 Day

☐ 2 Day ☐ 3 Day

☒ Standard (7 working days)

☐ \_\_\_\_\_  
(other)

Laboratory Number: 09-129

### Requested Analysis

Lab ID	Sample Identification	Date Sampled	Time Sampled	Matrix	# of Cont.	NWTPH-HCID	NWTPH-Gx/BTEX	NWTPH-Dx	Volatiles by 8260B	Halogenated Volatiles by 8260B	Semivolatiles by 8270C	PAHs by 8270C / SIM	PCBs by 8082	Pesticides by 8081A	Herbicides by 8151A	Total RCRA Metals (6)	TCLP Metals	HEM by 1664	VPH	EPH	% Moisture
1	P3	9-22-04	10:15	W	2			X													
2	P4	9-22-04	11:00	W	2			X													
3	P5	9-22-04	11:45	W	2			X													
4	P1A1	9-22-04	13:20	W	2			X													
5	P2	9-22-04	14:20	W	2			X													
6	P6A-10	9-22-04	14:50	W	2			X													X

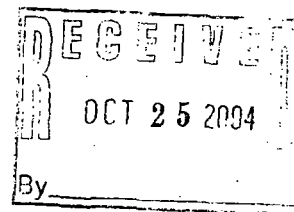
Signature	Company	Date	Time	Comments/Special Instructions
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Received by <u>Stacy Dumas</u>	<u>USE</u>	<u>9-22-04</u>	<u>17:40</u>	
Relinquished by				
Received by				
Relinquished by				
Received by				
Reviewed by/Date	Reviewed by/Date	Chromatograms with final report <input type="checkbox"/>		

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**OnSite  
Environmental Inc.**

Analytical Testing and Mobile Laboratory Services



October 21, 2004

Bruce Carpenter  
Herrera Environmental Consultants, Inc.  
2200 6<sup>th</sup> Avenue, Suite 1100  
Seattle, WA 98121

Re: Analytical Data for Project C00-01419-060  
Laboratory Reference No. 0409-129

Dear Bruce:

Enclosed are the analytical results and associated quality control data for samples submitted on September 22, 2004.

**Please note that page 3 has been revised, and replaces page 3 in the original report dated September 27, 2004.**

The standard policy of OnSite Environmental Inc. is to store your samples for 30 days from the date of receipt. If you require longer storage, please contact the laboratory.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning the data, or need additional information, please feel free to call me.

Sincerely,

  
David Baumeister  
Project Manager

Enclosures

Date of Report: September 27, 2004  
Samples Submitted: September 22, 2004  
Laboratory Reference: 0409-129  
Project: C00-01419-060

#### Case Narrative

Samples were collected on September 22, 2004 and received by the laboratory on September 22, 2004. They were maintained at the laboratory at a temperature of 2°C to 6°C.

General QA/QC issues associated with the analytical data enclosed in this laboratory report will be indicated with a reference to a comment or explanation on the Data Qualifier page. More complex and involved QA/QC issues will be discussed in detail below.

Date of Report: September 27, 2004  
Samples Submitted: September 22, 2004  
Laboratory Reference: 0409-129  
Project: C00-01419-060

**NWTPH-Dx**

Date Extracted: 9-23-04  
Date Analyzed: 9-23&10-19-04

Matrix: Water  
Units: mg/L (ppm)

Client ID:	P3	P4	P5
Lab ID:	09-129-01	09-129-02	09-129-03
Diesel Range:	ND	ND	ND
PQL:	0.25	0.25	0.26
Identification:	---	---	---
Lube Oil Range:	ND	ND	1.6
PQL:	0.40	0.40	0.41
Identification:	---	---	Bunker C
Surrogate Recovery			
o-Terphenyl:	85%	75%	89%
Flags:	Y	Y	Y

Date of Report: September 27, 2004  
Samples Submitted: September 22, 2004  
Laboratory Reference: 0409-129  
Project: C00-01419-060

**NWTPH-Dx**

Date Extracted: 9-23-04  
Date Analyzed: 9-23-04

Matrix: Water  
Units: mg/L (ppm)

Client ID:	P1A	P2
Lab ID:	09-129-04	09-129-05

Diesel Range:	ND	ND
PQL:	0.26	0.25
Identification:	---	---

Lube Oil Range:	ND	ND
PQL:	0.42	0.40
Identification:	---	---

Surrogate Recovery		
o-Terphenyl:	86%	84%

Flags:	Y	Y
--------	---	---

Date of Report: September 27, 2004  
Samples Submitted: September 22, 2004  
Laboratory Reference: 0409-129  
Project: C00-01419-060

**NWTPH-Dx**  
**METHOD BLANK QUALITY CONTROL**

Date Extracted: 9-23-04  
Date Analyzed: 9-23-04

Matrix: Water  
Units: mg/L (ppm)

Lab ID: MB0923W1

Diesel Range: ND  
PQL: 0.25  
Identification: ---

Lube Oil Range: ND  
PQL: 0.40  
Identification: ---

Surrogate Recovery  
o-Terphenyl: 84%

Flags: Y

Date of Report: September 27, 2004  
Samples Submitted: September 22, 2004  
Laboratory Reference: 0409-129  
Project: C00-01419-060

**NWTPH-Dx**  
**DUPLICATE QUALITY CONTROL**

Date Extracted: 9-23-04  
Date Analyzed: 9-23-04

Matrix: Water  
Units: mg/L (ppm)

Lab ID: 09-129-01 09-129-01 DUP

Diesel Range:	ND	ND
PQL:	0.25	0.25
RPD:	N/A	

Surrogate Recovery		
o-Terphenyl:	85%	88%
Flags:	Y	Y

Date of Report: September 27, 2004  
Samples Submitted: September 22, 2004  
Laboratory Reference: 0409-129  
Project: C00-01419-060

**NWTPH-Dx**

Date Extracted: 9-23-04  
Date Analyzed: 9-23-04

Matrix: Soil  
Units: mg/kg (ppm)

Client ID: P6A-10  
Lab ID: 09-129-06

Diesel Range: ND  
PQL: 33  
Identification: ---

Lube Oil Range: ND  
PQL: 66  
Identification: ---

Surrogate Recovery  
o-Terphenyl: 72%

Flags: Y



Date of Report: September 27, 2004  
Samples Submitted: September 22, 2004  
Laboratory Reference: 0409-129  
Project: C00-01419-060

**NWTPH-Dx**  
**METHOD BLANK QUALITY CONTROL**

Date Extracted: 9-23-04  
Date Analyzed: 9-23-04

Matrix: Soil  
Units: mg/kg (ppm)

Lab ID: MB0923S1

Diesel Range: ND  
PQL: 25  
Identification: ---

Lube Oil Range: ND  
PQL: 50  
Identification: ---

Surrogate Recovery  
o-Terphenyl: 95%

Flags: Y

Date of Report: September 27, 2004  
Samples Submitted: September 22, 2004  
Laboratory Reference: 0409-129  
Project: C00-01419-060

**NWTPH-Dx**  
**DUPLICATE QUALITY CONTROL**

Date Extracted: 9-23-04  
Date Analyzed: 9-23-04

Matrix: Soil  
Units: mg/kg (ppm)

Lab ID: 09-131-01 09-131-01 DUP

Diesel Range: 3750 3410

PQL: 25 25

RPD: 10

Surrogate Recovery  
o-Terphenyl: 121% 111%

Flags: Y Y

Date of Report: September 27, 2004  
Samples Submitted: September 22, 2004  
Laboratory Reference: 0409-129  
Project: C00-01419-060

**% MOISTURE**

Date Analyzed: 9-23-04

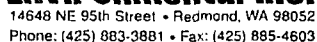
Client ID	Lab ID	% Moisture
P6A-10	09-129-06	24



## OnSite Environmental Inc.

### Data Qualifiers and Abbreviations

- A - Due to a high sample concentration, the amount spiked is insufficient for meaningful MS/MSD recovery data.
- B - The analyte indicated was also found in the blank sample.
- C - The duplicate RPD is outside control limits due to high result variability when analyte concentrations are within five times the quantitation limit.
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- H - The analyte indicated is a common laboratory solvent and may have been introduced during sample preparation, and be impacting the sample result.
- I - Compound recovery is outside of the control limits.
- J - The value reported was below the practical quantitation limit. The value is an estimate.
- K - Sample duplicate RPD is outside control limits due to sample inhomogeneity. The sample was re-extracted and re-analyzed with similar results.
- L - The RPD is outside of the control limits.
- M - Hydrocarbons in the gasoline range (toluene-napthalene) are present in the sample.
- O - Hydrocarbons indicative of diesel fuel are present in the sample and are impacting the gasoline result.
- P - The RPD of the detected concentrations between the two columns is greater than 40.
- Q - Surrogate recovery is outside of the control limits.
- S - Surrogate recovery data is not available due to the necessary dilution of the sample.
- T - The sample chromatogram is not similar to a typical \_\_\_\_\_.
- U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
- V - Matrix Spike/Matrix Spike Duplicate recoveries are outside control limits due to matrix effects.
- W - Matrix Spike/Matrix Spike Duplicate RPD are outside control limits due to matrix effects.
- X - Sample extract treated with a silica gel cleanup procedure.
- Y - Sample extract treated with an acid/silica gel cleanup procedure.
- Z -
- ND - Not Detected at PQL
- PQL - Practical Quantitation Limit
- RPD - Relative Percent Difference



## Page 1 of 1

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